

Two New Species of *Neurolepis* (Poaceae: Bambuseae) from Colombia

Gerrit Davidse

Missouri Botanical Garden, P.O. Box 299, St. Louis, Missouri 63166-0299, U.S.A.

Lynn G. Clark

Department of Botany, 353 Bessey Hall, Iowa State University, Ames, Iowa 50011, U.S.A.

ABSTRACT. Two narrowly endemic bamboos from Colombia are described, illustrated, and compared to their putative relatives. *Neurolepis silverstonei* Davidse & L. G. Clark is described from collections made on Cerro del Torrá, Chocó. It is related to *N. aperta* but differs in its smaller stature, leaves, ligules, and inflorescences, and in its longer spikelets and lower sterile lemma. *Neurolepis petiolata* Davidse & L. G. Clark is described from Antioquia. It is unique in the genus in possessing a pilose callus and is unusual in its long and highly differentiated pseudopetioles. It is probably closely related to *N. aperta*, but additionally differs from that species by longer spikelets, and characters of the sterile lemmas and the palea.

Neurolepis Meissner is a genus of woody bamboos atypical in its unbranched culms, relatively large, long and narrow, persistent leaves, pseudopetioles that are often not well differentiated from the blade, and a lack of well-developed, elongated, vegetative culm internodes. However, *N. aristata* (Munro) Hitchcock and several related species are exceptional in having elongated vegetative culm internodes, and the newly described *N. petiolata* and *N. aperta* (Munro) Pilger differ in having elongated, well-differentiated pseudopetioles. The leaf blades of species such as *N. aperta*, *N. pittieri* McClure, and *N. nobilis* (Munro) Pilger are the largest in the grass family (Soderstrom, 1969), reaching 3 m or more in length. The genus is distributed primarily along the main cordillera from southern Costa Rica to Andean Bolivia, with outlying populations in the coastal cordillera of Venezuela (including the Paria Peninsula of Venezuela), Trinidad, and the Guayana Highland of Venezuela and Brazil (Soderstrom, 1969; McClure, 1973; Soderstrom & Ellis, 1987).

Soderstrom (1969) revised the genus and recognized nine species. Recent collections from Colombia could not be identified with any currently recognized species and are described here as two new species in the *N. aperta* species complex.

Neurolepis silverstonei Davidse & L. G. Clark, sp. nov. TYPE: Colombia. Chocó: Municipio de San José del Palmar, Cerro del Torrá, filo de cumbre, vegetación abierta herbácea y arbustiva, ca. 2730 m, hierba hasta 200 cm altura, brácteas e inflorescencia rojo-violetas, 15 ago. 1988, F. A. Silverstone-Sopkin, N. Paz, R. T. González, A. Henao, J. E. Ramos & L. H. Ramos 4409 (holotype, CUVIC; isotypes, ISC, MO). Figures 1, 2.

Culmi 1–2 m alti, erecti, simplices. Vaginae foliorum glabrae, apex prolongatus in quoque late, glabrus, adnatus ad ligulam interioram; ligula interiora cum apice vaginorum prolongato 16–25 mm longa, bicarinata, carinae parum alatae ad basim fimbrias 8–12 mm longas gerentes; pseudopetiolus 3–5 cm longus, adaxialiter sulcatus; laminae 30–44 cm longae, 12–22 mm latae, lineari-oblongatae, asymmetricae. Inflorescentia 25–55 cm longa, paniculata, solitaria, aperta; rhachis glabra; rami primarii usque ad 35 cm longi, patentes. Spiculae 9.0–10.4 mm longae, paucae; glumae 2, inaequales, obtusae, enervis; gluma inferiora 0.9–1.6 mm longa; gluma superiora 1.7–2.5 mm longa; lemmata sterilia 2, acuminata, adaxialiter glabra; lemma sterile inferiore 6.1–8.1 mm longum; lemma sterile superiore 7.6–9.8 mm longum; lemma fertile 8.0–10.0 mm longum, acuminatum; palea 1.0–1.4 mm brevior quam lemma fertile.

Caespitose, clump-forming perennial 1–2 m tall. Culms ca. 4 mm diam., erect, unbranched, herbaceous; internodes not elongated, completely covered by the leaf sheaths; nodes not visible. Leaves not differentiated into culm and foliage leaves, basal; sheaths open, glabrous, the summit prolonged on each side, glabrous, adnate to the inner ligule; ligular unit 16–25 mm long, 2-keeled, the keels slightly winged toward the base and bearing readily disintegrating fimbriae 8–12 mm long; outer ligule not differentiated; pseudopetiole 3–5 cm long, sulcate adaxially, not well differentiated from the blade, eventually obliquely disarticulating at the junction with sheath; blades 30–44 cm long, 12–22 mm wide, linear-oblongate, glabrous except for a few hispid hairs along the margin near the base, asymmetrical, abruptly acute apically, long-

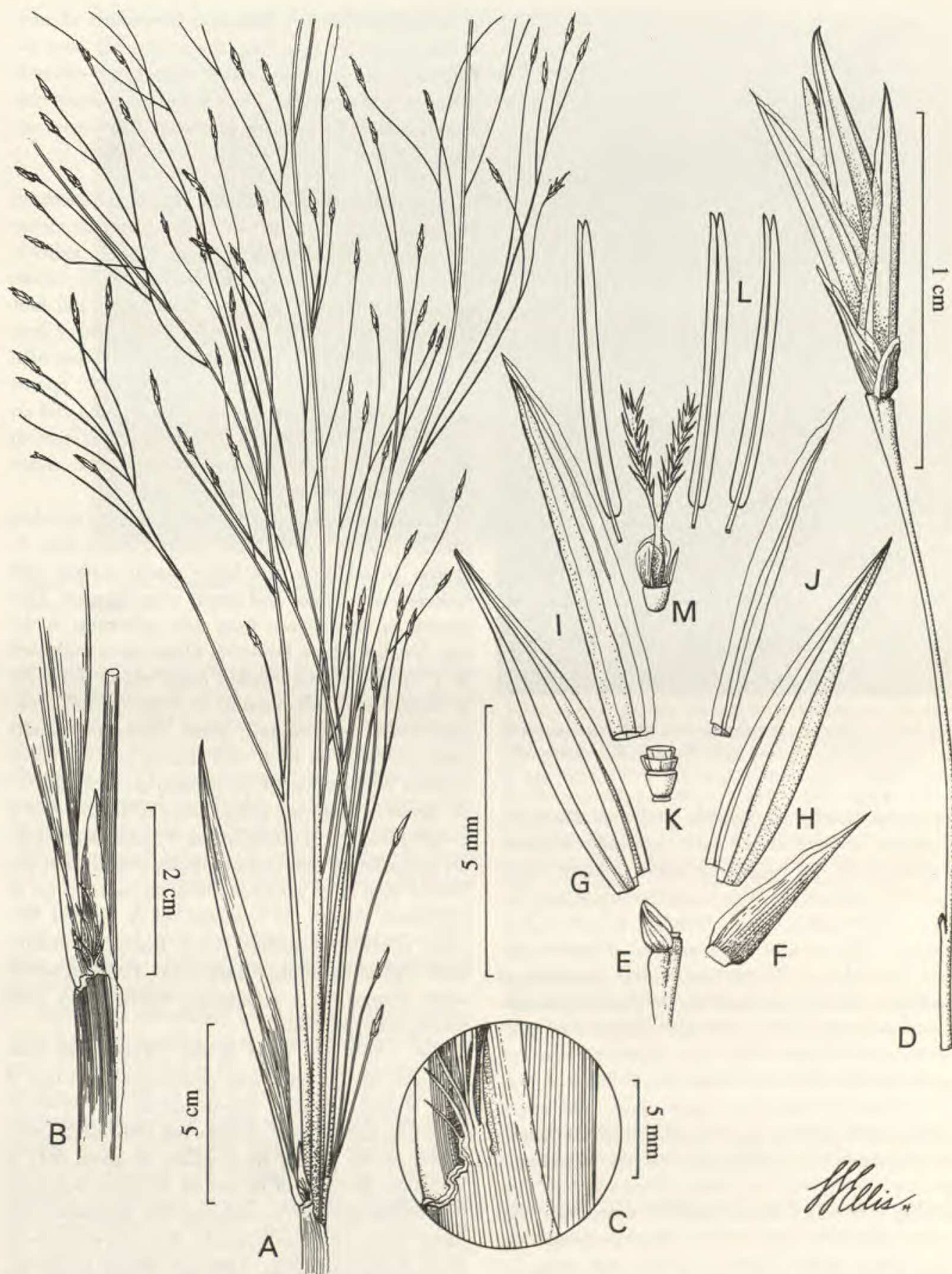


Figure 1. *Neurolepis silverstonei* Davidse & L. G. Clark. —A. Inflorescence and uppermost leaf blade. —B. Portion of the leaf in the ligular area. —C. Close-up of the ligular area showing fimbriae. —D. Long-pedicelled spikelet. E–M. Dissected spikelet. —E. Lower glume. —F. Upper glume. —G. Lower sterile lemma. —H. Upper sterile lemma. —I. Fertile lemma. —J. Palea. —K. Lower portion of the rachilla showing the prominent glumar internode. —L. Stamens. —M. Gynoecium with three lodicules. A–C based on *Silverstone-Sopkin et al.* 4399 (MO); D–M based on *Silverstone-Sopkin et al.* 4409 (MO).



Figure 2. Close-up of inflorescence of *N. silverstonei* at the type locality. A cloud bank obscures the background.

attenuate basally, the midrib projected abaxially, shallowly sulcate at the base adaxially. Inflorescence 25–55 cm long, paniculate, solitary, open, spreading, usually terminal, rarely axillary from the base of the plant; rachis shallowly sulcate to flattened on the side of the branches, glabrous; primary branches to 35 cm long, widely spreading at maturity, basally prominently pulvinate with glabrous pulvinii, solitary, sparingly rebranched; pedicels much longer than the spikelets, slender. Spikelets 9.0–10.4 mm long, few, 3-flowered, disarticulating between the upper glume and lowest sterile floret; glumes 2, unequal, obtuse, nerveless, stramineous; lower glume 0.9–1.6 mm long; upper glume 1.7–2.5 mm long; sterile florets 2, each consisting only of a lemma, purplish, acuminate, glabrous abaxially, scaberulous adaxially toward the tip; lower sterile lemma 6.1–8.1 mm long, 3–4-nerved; upper sterile lemma 7.6–9.8 mm long, 3–5-nerved; upper floret with a bisexual flower; fertile lemma 8.0–10.0 mm long, 3–5-nerved, acuminate boat-shaped, glabrous abaxially, scaberulous adaxially at the tip; palea 1.0–1.4 mm shorter than the fertile lemma, 2–3-nerved, convex on the back in the lower $\frac{1}{2}$, 1-keeled and boat-shaped at the apex,

glabrous; lodicules 3, flattened, irregularly obtuse, eciliate, 1.2–1.4 mm long, the 2 anterior ones 4–6-nerved, the posterior much narrower, 1-nerved; stamens 3, the anthers 3.5–5.0 mm long; ovary glabrous; styles 2; stigmas plumose. Caryopsis not seen.

As Soderstrom (1969) noted, *Neurolepis aperta* is the most distinctive species in the genus by virtue of its short, obtuse glumes, long, delicate pedicels much longer than the spikelet, and an easily visible elongated internode between the glumes and first sterile lemma. Except for the relatively longer, less obtuse upper glume, these characteristics are also shared with *N. silverstonei*. In addition, *N. aperta* and *N. silverstonei* share a nonsulcate palea and an inner ligule that is much elongated and adnate to the sheath summit prolongations, with the entire unit winged or fimbriate on the keels.

However, *N. silverstonei* is much shorter and has smaller blades, ligules, and inflorescences than *N. aperta*. In addition, the lower sterile lemma and spikelets are longer and much more slender. This species is only known from five gatherings at the type locality where flowering plants were collected by P. A. Silverstone-Sopkin (after whom the plant is named) and collaborators in August 1982, January 1984, and August 1988. Flowering plants were collected on each visit, but it was not noted whether all members of the population were in flower. Because flowering plants were collected over a 6-year period, it is unlikely that *N. silverstonei* flowers gregariously and synchronously over a short period of time (1–2 years) followed by many years of vegetative growth, as reported for *N. pittieri* McClure (Davidse & Huber, 1979). Instead, a continuous type of flowering (Clark et al., 1989) in which some clumps in a population flower every year seems more probable.

The Cerro del Torrá is the largest and most northerly of a chain of four peaks, the Cordillera of San Miguel, located approximately at 04°46'N, 76°29'W, and separated from the Cordillera Occidental of the Andes by a valley of about 600 m elevation. Because of its remote location, botanical collections have been made on this mountain only three times, all expeditions by the Universidad del Valle (Cali, Colombia). Although official published maps show various elevations up to 4670 m (Mapa Físico Político, escala 1:1,500,000, Ministerio de Hacienda y Crédito Público, Instituto Geográfico de Colombia "Agustín Codazzi," 1979), the true elevation is about 2770–2800 m.

Collections were made only on the eastern slope of the Cerro del Torrá up to the summit and on the



Figure 3. Open, ridge-top shrub vegetation, the habitat at the type locality of *Neurolepis silverstonei*, Cerro del Torrá, Chocó, Colombia.

summit of the adjacent peak, Cerro Panamá. Vegetation of this zone consists of primary cloud forest up to about 2500 m, where shrubby vegetation occurs; above this, nearly to the summit, is dense dwarf forest. The vegetation of the summit ridge is open, dominated by shrubs, herbs, and ferns. The soil is moist and covered in places by mats of *Sphagnum* and lichens. A small number of dwarf (to about 4 m), widely separated trees and palms are present. The summit ridge is usually covered with mist, and rainfall is heavy (probably over 6000 mm annually, although no yearly measurements have been made).

Neurolepis silverstonei occurs only in the very humid open community on the summit ridge (Fig. 3), not in the forest below the ridge. It may be endemic to the summits of the Cordillera de San Miguel, although the flora of much of the Cordillera Occidental is not well known. In support of the hypothesis of endemism and indicative of the phytogeographic importance of the Cerro de Torrá is the discovery there in 1984 of *Alzatea verticillata* Ruiz & Pavón (Alzateaceae), the only Colombian record of this monotypic family (Silverstone-Sopkin & Graham, 1986).

Paratypes. COLOMBIA. **Chocó:** Municipio San José del Palmar, Cerro del Torrá, cumbre del Torrá Grande, vegetación abierto con *Blechnum*, *Paepalanthus*, ciclan-táceas, gramíneas y arbustos pequeños, pocos árboles, musgos forman alfombra espesa mojada, 2730 m, hierba terrestre, inflorescencia rojo-violeta oscura, 13 ene. 1984,

F. A. Silverstone-Sopkin, N. Paz, A. Duque & H. Bayona 1823 (CUVC, MO, RSA); Cerro del Torrá, cumbre, rastrojo primario bajo abierto, dominado por *Blechnum*, *Paepalanthus*, una gramínea, y arbustivos, muy pocos árboles, aunque se encuentran plántulas de *Clusia*, 2730–2770 m, 8 ago. 1982, F. A. Silverstone-Sopkin & A. Henao 1265 (CUVC—4 sheets, MO—3 sheets, ISC, TULV, US—2 sheets), 18 ago. 1982, F. A. Silverstone-Sopkin, A. Henao & R. Gómez 1378 (CUVC); Cerro del Torrá, filo de Cumbre, vegetación abierta herbácea y arbustiva, ca. 2730 m, hierba 103 cm altura, tallos e inflorescencia rojo-violetas, 14 ago. 1988, F. A. Silverstone-Sopkin, N. Paz, R. T. González, A. Henao, J. E. Ramos & L. H. Ramos 4399 (CUVC, MO).

Neurolepis petiolata Davidse & L. G. Clark, sp. nov. TYPE: Colombia. Antioquia: Municipio de La Unión, Km 32.5 of road Sonsón–La Unión (23.5 km from La Unión), montane vegetation on slopes near stream, 05°52'N, 75°18'W, 2300 m, large clump-forming grass with culms to 4 m tall, above stream at forest margin, 4 Oct. 1987, J. L. Zarucchi, A. E. Brant & F. J. Roldán 6265 (holotype, HUA; isotypes, COL not seen, ISC, MO). Figure 4.

Culmi 1–2 m alti, ca. 4 m alti cum inflorescentiis, erecti, simplices. Vaginae foliorum glabrae, apex valde prolongatus in quoque latae, glabrus vel puberulentus, adnatus ad ligulam interioram; ligula interiora cum apice vaginorum prolongato 4–12 cm longa, bicarinata, carinae alatae; pseudopetiolus 21–46 cm longus, $\frac{1}{3}$ – $\frac{1}{2}$ laminam attingens, glabrus, adaxialiter valde sulcatus; laminae 67–93 cm longae, 7–11 cm latae, oblanceolatae, glabrae, asymmetricae, costa parum excentrica. Inflorescentia 80–

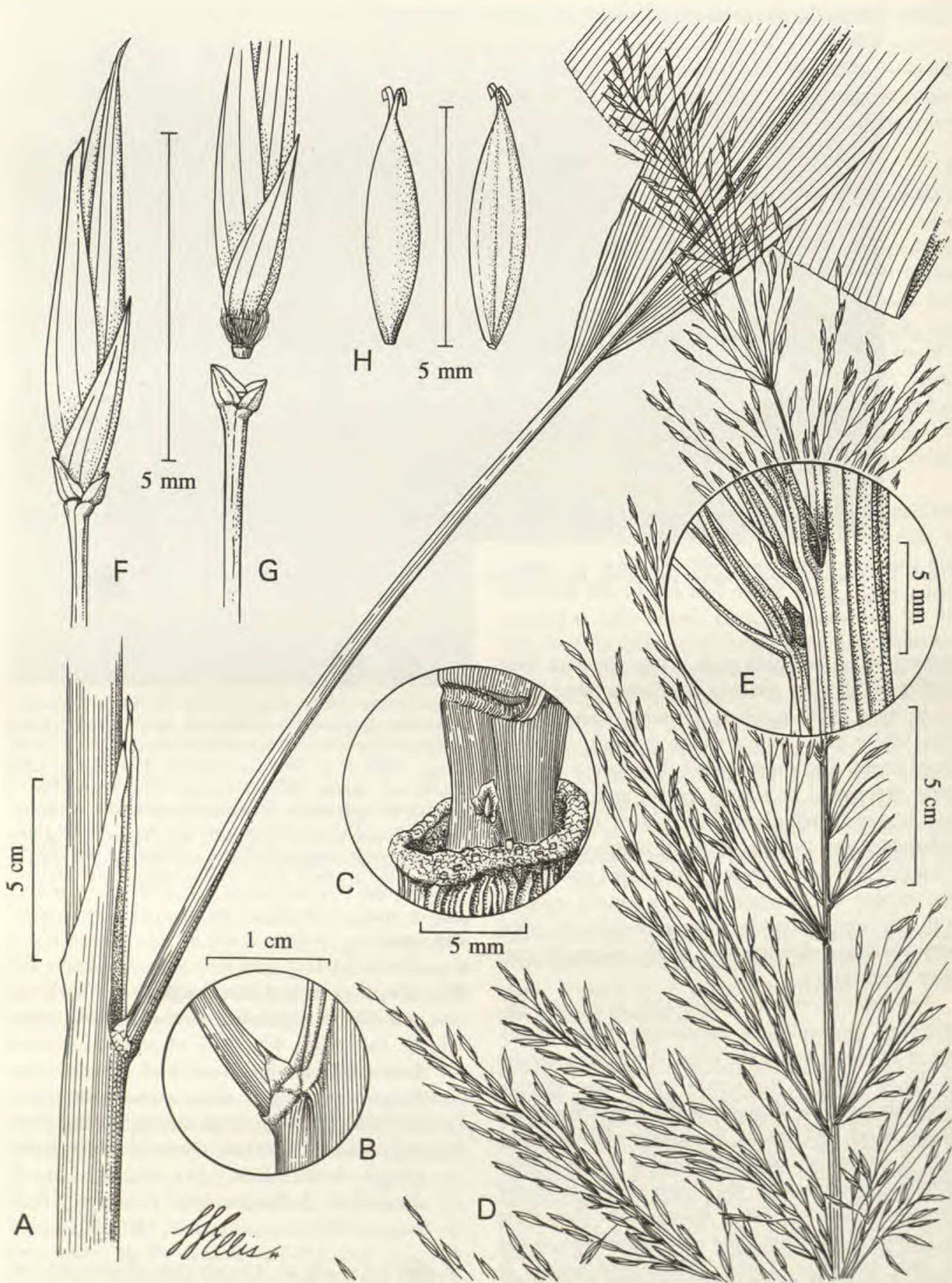


Figure 4. *Neurolepis petiolata* Davidse & L. G. Clark. —A. Portion of a fully developed leaf showing the apex of the sheath, ligular area, pseudopetiole, and base of the blade. —B. Close-up of base of pseudopetiole. —C. Portion of a culm with a solitary axillary bud. —D. Portion of the inflorescence. —E. Close-up of the base of some inflorescence branches showing the swollen pulvinii. —F. Spikelet. —G. Disarticulated spikelet showing the small glumes and the hairy callus of the lower sterile lemma. —H. Nearly mature caryopsis showing the embryo side (left) and the hilum side (right). Based on Zarucchi *et al.* 6265 (MO).

160 cm longa, paniculata, solitaria, aperta; rhachis glabra; rami primarii usque ad 36 cm longi. Spiculae 8.0–9.8 mm longae, numerosae; glumae 2, inaequales; gluma inferiora 0.3–0.6(–1.6) mm longa, obtusa; gluma superiora 0.9–1.7 mm longa, obtusa vel emarginata vel irregulariter sinuata; lemmata sterilia 2, abaxialiter glabra, scariosa vel membranacea ad apicem; lemma sterile inferiore 4–6 mm longum, acutum, callus pilosus; lemma sterile superiore 6–7 mm longum, 5-nerve; lemma fertile 7–9 mm longum, acuminatum, abaxialiter glabrum; palea 0.3–1.0 mm brevior quam lemma fertile.

Clump-forming perennial 1–2 m tall, ca. 4 m tall with inflorescences, with a few aerial or prop roots from the lowest culm nodes. Rhizome sympodial, short, thin, compact. Culms 1–1.5 cm diam., erect, unbranched except for innovations produced at the base, herbaceous to woody; nodes glabrous; internodes mostly not elongated except for several ones in flowering culms, glabrous, solid or the pith breaking down. Leaves primarily basal but basal and cauline in flowering culms, not differentiated into culm and foliage leaves but with a few bladeless cataphylls at the base; sheaths open, glabrous, the summit conspicuously prolonged on each side, adnate to the inner ligule; ligular unit 4–12 cm long, prominently 2-keeled, each keel distinctly winged, its margins (formed from the sheath summit prolongations) glabrous or appressed puberulent toward the apex, its back (formed from the ligule) appressed puberulent; outer ligule 2–4 mm long, membranous, ciliolate, appressed puberulent or glabrescent; pseudopetiole 21–46 cm long, $\frac{1}{3}$ – $\frac{1}{2}$ as long as the blade, glabrous, prominently sulcate adaxially, pulvinate in the axil with the ligule, articulated with the sheath and eventually breaking off; blades 67–93 cm long, 7–11 cm wide, oblanceolate, glabrous, asymmetrical, especially basally, acute apically, the midrib slightly eccentric, projected abaxially, shallowly sulcate adaxially. Inflorescence 80–160 cm long, paniculate, solitary, terminal, open, spreading; rachis ridged, glabrous; primary branches to 36 cm long, widely spreading at maturity, basally prominently pulvinate with glabrous pulvinii, solitary but repeatedly rebranched near the base; pedicels usually as long as or much longer than the spikelet. Spikelets 8.0–9.8 mm long, numerous, 3-flowered, disarticulating between the upper glume and lowest sterile floret; glumes 2, unequal, nerveless, stramineous; lower glume 0.3–0.6(–1.6) mm long, obtuse; upper glume 0.9–1.7 mm long, obtuse to emarginate or irregularly wavy; sterile florets 2, each consisting of only a lemma, purplish, glabrous abaxially, scaberulous adaxially toward the tip; lower sterile lemma 4–6 mm long, 3–5-nerved, acute, membranous toward the apex, otherwise chartaceous, appressed pilose basally

with callus hairs 0.5–1 mm long; upper sterile lemma 6–7 mm long, 5-nerved, apically slightly boat-shaped, membranous toward the apex, otherwise chartaceous, basally glabrous; fertile floret with a bisexual flower; fertile lemma 7–9 mm long, 5–7-nerved, acuminate with an awn tip to 0.6 mm long, glabrous abaxially, scaberulous adaxially in the upper $\frac{1}{3}$; palea 6–7 mm long, 0.3–1.0 mm shorter than the upper lemma, 4-nerved, convex on the back, glabrous abaxially, scaberulous adaxially toward the tip; lodicules 3, multinerved, flattened, eciliate, the 2 anterior ones 1.4–1.5 mm long, the posterior 1 narrower than the anterior ones; stamens 3, the anthers 5.1–5.2 mm long; ovary glabrous; styles 2. Caryopsis 5.2–5.5 mm long, nearly flat on the hilum side, convex on the embryo side; hilum linear, as long as the caryopsis; embryo ca. $\frac{1}{5}$ as long as the caryopsis.

In May 1988, J. L. Zarucchi (pers. comm.) revisited the locality where the type collection (Zarucchi *et al.* 6265) had been collected about six months earlier and observed that all plants had completely died. No evidence of seedlings was found, although it could not be positively ruled out that the species failed to reproduce itself, because we do not know anything about its germination requirements. Plants with mature inflorescences at anthesis were found in the same area in February 1988 by X. Londoño and L. G. Clark (Londoño & Clark 403). A visit to this site in 1994 revealed that it is now a potato field, but further upstream, juvenile plants and relatively young seedlings were found (Londoño & Clark 901). Inaccessible, but apparently mature clumps of what appeared to be this species were also observed by Londoño and Clark in 1994 at 2060 m elevation along a river gorge 4.5 km below Concepción, northeast of Medellín, about 55–60 km north of the type locality. Some of these plants appeared to be in the early stages of flowering, with immature inflorescences just emerging.

The synchronous flowering and death of all individuals in this population indicates that it probably has a similar life history to that described for *Neurolepis pittieri* McClure, the only other species in the genus for which a periodic, synchronous flowering life history has been established (Davidse & Huber, 1979) with some certainty. Although it can only be hypothesized for *N. petiolata*, it seems likely that the intervals between flowering last for a number of years, as is typical of the majority of species of the Bambuseae (Soderstrom & Ellis, 1987). If the population observed near Concepción

is indeed this species, it may represent a divergence in synchrony of flowering due to isolation.

Neurolepis petiolata is closely related to *N. aperta* (Munro) Pilger and more distantly to *N. silverstonei*, as indicated by the nonsulcate palea, long-pedicelled spikelets, well-developed internode between the upper glume and lower sterile floret, and much elongated inner ligule adnate to the sheath summit prolongations, with the entire ligular unit winged or fimbriate on the keels.

Neurolepis petiolata differs from *N. aperta* in the much longer (21–46 cm vs. (1–2)7–22 cm), more slender pseudopetiole that is abruptly differentiated from the blade versus the blade gradually and long-attenuate into the pseudopetiole, its pilose versus glabrous base of the lower sterile lemma, its longer spikelets (8.0–9.8 mm vs. 5.0–7.2(–8.0) mm), the adaxial puberulence of the sterile lemmas restricted toward the tips versus most of the adaxial surface, the membranous texture of the sterile lemmas toward their apices versus chartaceous throughout, the 5-nerved versus 3-nerved upper sterile lemma, and the 4-nerved versus 2-nerved palea. The difference in development of the pseudopetiole is also very obvious if taken as a proportion of the blade length: in *N. petiolata*, the pseudopetiole reaches $\frac{1}{3}$ to $\frac{1}{2}$ the blade length, even in the leaves of juvenile plants, whereas it reaches no more than $\frac{1}{10}$ the blade length in even the best developed leaves of *N. aperta*. *Neurolepis petiolata* typically grows along riverbanks in montane forest at elevations of 2060 to 2400 m, whereas *N. aperta* usually occurs from 2800 to 3600 m in upper montane and cloud forests and páramo vegetation.

Callus hairs are unique among the described species of *Neurolepis*. Hairs such as these are common in grasses in general and typically function in positioning seeds into more favorable germinating conditions.

Paratypes. COLOMBIA. **Antioquia:** La Unión, Corr. Mesopotamia, Río El Cardal, 0.5 km below La Frontera, 2400 m, 28 Feb. 1988 (fl), X. Londoño & L. G. Clark 403 (COL, HUA, ISC, TULV, US); Mun. La Unión, Corr. Mesopotamia, a mano izquierda del puente sobre el Río Car-

dal, arriba de la truchera, 2330 m, 18 June 1994, X. Londoño & L. G. Clark 901 (COL, HUA, ISC, TULV).

Acknowledgments. We thank Philip (Felipe on specimen labels) A. Silverstone-Sopkin and Jorge E. Ramos-Pérez (CUVC) for providing us with the specimens and photographs from Cerro del Torrá, as well as the very useful description of the habitat included in this paper. James L. Zarucchi and Alan E. Brant kindly provided the first specimens and observations on the flowering behavior of *N. petiolata*. Collections from the Cerro del Torrá in 1988 were financed by Grant 3884–88 from the National Geographic Society to Silverstone-Sopkin. Transportation for the 1982 expedition was partially supported by INCIVA (Instituto Vallecaucano de Investigaciones Científicas). Fieldwork by Clark in 1988 was supported by an Iowa State University (ISU) Foreign Travel Grant and an ISU Research Grant, and conducted under the auspices of INCIVA; fieldwork in 1994 was supported by National Science Foundation Grant DEB-9218657. The invaluable assistance of Ximena Londoño is gratefully acknowledged. We thank Linda S. Ellis for the illustrations.

Literature Cited

- Clark, L. G., G. Davidse & R. P. Ellis. 1989. Natural hybridization in bamboos: Evidence from *Chusquea* sect. *Swallenochloa* (Poaceae: Bambusoideae). *Natl. Geogr. Res.* 5: 459–476.
- Davidse, G. & O. Huber. 1979. Notes on the flowering and life history of *Neurolepis pittieri* (Gramineae, Bambusoideae). *Ann. Missouri Bot. Gard.* 66: 900–902.
- McClure, F. A. 1973. Genera of bamboos native to the New World. *Smithsonian Contr. Bot.* 9: 1–148. [Edited by T. R. Soderstrom.]
- Silverstone-Sopkin, P. A. & S. A. Graham. 1986. Alzateaceae, a plant family new to Colombia. *Brittonia* 38: 340–343.
- Soderstrom, T. R. 1969. Gramineae. In: *Botany of the Guayana Highland—Part viii*. *Mem. New York Bot. Gard.* 18: 12–22.
- & R. P. Ellis. 1987. The position of bamboo genera and allies in a system of grass classification. Pp. 225–238 in T. R. Soderstrom, K. W. Hilu, C. S. Campbell & M. E. Barkworth (editors), *Grass Systematics and Evolution*. Smithsonian Institution Press, Washington, D.C.